

# **STUDY OF MACHINING TIME IN END MILLING PROCESS ON H-13 DIE STEEL**

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Received 06 March 2018 Received in revised form 08 March 2018 Accepted 12 March 2018

Available online 20 March 2018

## **ABSTRACT**

Milling is one of the most popular metal removal processes in hard steel machining process. H13 die steel play an important role in manufacturing of extrusion dies, cutting tools and punching tools. In this experimental work, studying performance of machining time of end milling process in H13 die steel using end milling cutter. L<sub>16</sub> orthogonal array is used as design of experiment in end milling process. Milling process parameters of cutting speed, feed and depth of cut are the input parameters of end milling process and response parameter of machining time is consider in end milling process. The objective of this work minimizes the machining time and maximizing the productivity with good surface finish.

**Keywords:** End milling, H13 die steel, process parameters, DOE, Machining time

## **1. Introduction**

End milling process in hard steel is much complicated to produce grooves and slots. End milling process takes more cutting pressure and machining time to machine the harden steel. Lowest machining time of milling process can improve production rate. O.Y.Venkatasubbareddy et al (2017) are conducted experimental investigation of H13 Die steel using end milling process using Taguchi based grey relational analysis. They are investigated optimum cutting parameters of milling process with different process parameters. The optimum parameters of milling is low spindle speed, high feed rate and high depth of cut in MRR. Mandeep chahal et al (2013) are conducted to estimate the range of process parameters for optimization of surface roughness and Material Removal Rate in CNC Milling. They investigated the range of process parameters with optimization of surface roughness and Material Removal Rate in CNC milling

process. The optimum parameters of milling is low spindle speed and good surface roughness and MRR in CNC Milling. Nikhil aggarwal et al (2014) are Optimized machining parameters in end milling of AISI H11 steel alloy by Taguchi based grey relational analysis. They are optimization of machining parameters in milling process with different process parameters. The machining parameters of milling is low spindle speed, high feed rate and high depth of cut in MRR. Jatin et al (2013) are investigated the effect of machining parameters on output characteristics of CNC milling using Taguchi optimization technique. They are optimized the machining parameters with different process parameters. The optimum parameters of milling is high cutting speed, feed rate and depth of cut. TTM.kannan et al (2013) is optimized milling parameters of EN8 using Taguchi Methodology. They are optimization of milling parameters with different process

parameters and found low depth of cut produce lower surface roughness.

## **2. Experimental Details**

### **2.1 Machine used : Vertical Milling machine**



Fig 1 Vertical milling machine



Fig 2End milling cutter

### **2.2 Work piece :**

H13 Die Steel is a versatile chromium-molybdenum hot work steel, that is widely used in hot work and cold work tooling application. The hot hardness of

H13 resists thermal fatigue cracking which occurs as a result of cyclic heating and cooling cycles in hot work tooling application

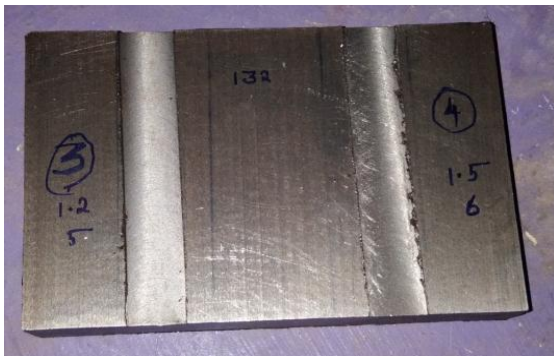


Fig 3 H13 Die steel



Fig 4 Stop watch

### **2.3 Stop watch**

It is a handheld time piece designed to measure the amount of time elapsed from a particular time when it is activated to the time when the piece is deactivated.

In fully automatic time, both starting and stopping are triggered automatically. They can be used to count the time in increments of 0.01 seconds

**Table 1 L16 Orthogonal Array for milling process parameters**

| Test No | Spindle speed | Feed rate | Depth of cut |
|---------|---------------|-----------|--------------|
| 1       | 1             | 1         | 1            |

|    |   |   |   |
|----|---|---|---|
| 2  | 1 | 2 | 2 |
| 3  | 1 | 3 | 3 |
| 4  | 1 | 4 | 4 |
| 5  | 2 | 1 | 2 |
| 6  | 2 | 2 | 1 |
| 7  | 2 | 3 | 4 |
| 8  | 2 | 4 | 3 |
| 9  | 3 | 1 | 3 |
| 10 | 3 | 2 | 4 |
| 11 | 3 | 3 | 1 |
| 12 | 3 | 4 | 2 |
| 13 | 4 | 1 | 4 |
| 14 | 4 | 2 | 3 |
| 15 | 4 | 3 | 2 |
| 16 | 4 | 4 | 1 |

### 3. Result and discussion;

The experiment is designed L 16 Taguchi design of Experiment and machining time is predicted. During machining of H-13 die steel produce good surface finish in lower machining time. Here smaller the best

concept is used to predict lower machining time. The spindle speed ,feed and depth of cut are considered for milling process as input parameter and lower machining is the response paramete

**Table 2 End milling process parameters for Lower machining time**

| Test No | Spindle Speed (rpm) | Feed Rate (mm/rev) | Depth of Cut (mm) | Machining Time (sec) |
|---------|---------------------|--------------------|-------------------|----------------------|
| 1       | 132                 | 4                  | 0.5               | 323                  |
| 2       | 132                 | 6                  | 0.8               | 252                  |
| 3       | 132                 | 7                  | 1.2               | 153                  |
| 4       | 132                 | 9                  | 1.5               | 148                  |
| 5       | 227                 | 4                  | 0.8               | 100                  |
| 6       | 227                 | 6                  | 0.5               | 88                   |

|    |     |   |     |     |
|----|-----|---|-----|-----|
| 7  | 227 | 7 | 1.5 | 82  |
| 8  | 227 | 9 | 1.2 | 90  |
| 9  | 384 | 4 | 1.2 | 53  |
| 10 | 384 | 6 | 1.5 | 63  |
| 11 | 384 | 7 | 0.5 | 57  |
| 12 | 384 | 9 | 0.8 | 106 |
| 13 | 454 | 4 | 1.5 | 276 |
| 14 | 454 | 6 | 1.2 | 145 |
| 15 | 454 | 7 | 0.8 | 216 |
| 16 | 454 | 9 | 0.5 | 246 |

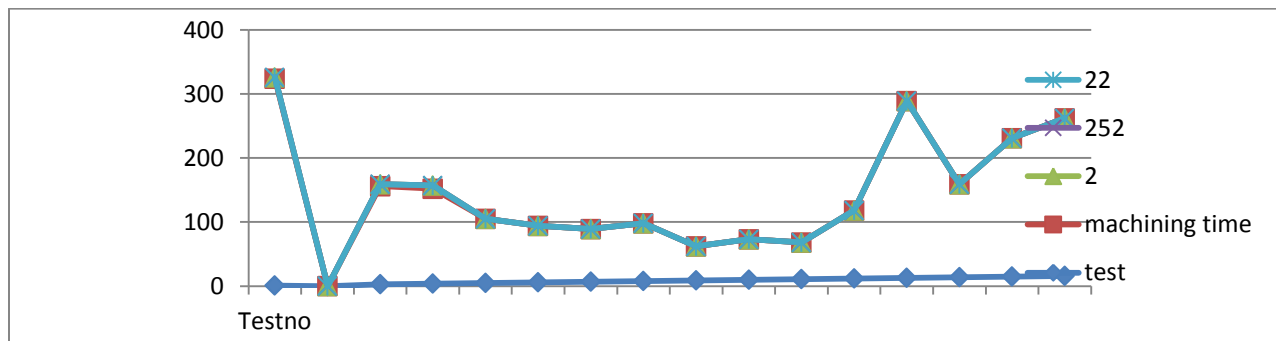


Fig 5 Relation between machining time related experiments

#### 4. Conclusion

In this experimental work the end milling process on H13 die steel were conducted and predicted lower machining time with good surface finish.

- The best parameter of end milling process on die steel are 384rpm of spindle speed, 4mm/rev of feed rate and 1.2 depth of cut.

- H13 die steel provided good machinability property and suitable for manufacturing extrusion die and punching machines.
- During end milling process consume less electrical power and produce minimum vibration on die steel machining process

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